Bellingham in Front of PFAS Testing for Drinking Water and Wastewater

Executive Summary

Labeled "forever chemicals", per- and polyfluoroalkyl substances (PFAS) are a prominent topic of concern in today's health and regulatory conversations. Most recently, the U.S. Environmental Protection Agency (EPA) proposed a PFAS National Primary Drinking Water Regulation seeking to establish protective Maximum Contaminant Levels (MCLs) to limit PFAS in the nation's drinking water. Testing for these chemicals is already being performed in Bellingham and we can confirm that no detectable levels of PFAS have been found in Bellingham's drinking water.

Beyond potable water, PFAS have been labeled contaminants of emerging concern for the environment. Federal, state and local agencies are all working to better understand the sources and prevalence of these chemicals in our natural systems. Treatment of municipal wastewater/biosolids is one of many options being looked at. To that end, the City of Bellingham (COB) has been participating in state and self-sponsored PFAS waste stream monitoring since 2009, with minimal amounts of poly-fluorinated chemicals discovered.

The science surrounding PFAS is advancing at a rapid pace. Action plans are being published. Regulatory limits are being promulgated. Analytical methodologies that achieve lower detection levels are in development. Source controls are being put in place. Treatment, mitigation and disposal options are being researched. As part of Bellingham's ongoing commitment to protecting public health and the environment, the City of Bellingham is proactively engaged in PFAS sampling efforts.

What Are PFAS Chemicals and Why Are They a Concern?

Per- and polyfluoroalkyl substances (PFAS) are a group of man-made chemicals that have been used in a variety of products since the 1950s. By 2021, the EPA estimated that there were about 250 commercial and industrial products containing PFAS in use globally. PFAS are found in many consumer products such as non-stick cookware, stain-resistant carpets, water-resistant clothing, and food packaging. Industrial uses include lubricants, protective coatings, electroplating, and firefighting foam. PFAS compounds repel water and oil, remain chemically and thermally stable, and exhibit surfactant properties, which are what make them useful for commercial and industrial applications. PFAS have strong, stable carbon-fluorine (C-F) bonds, making them resistant to hydrolysis, photolysis, microbial degradation, and metabolism.

Properties that make PFAS attractive for use in products are also what make them so persistent in the environment and causes them to build up over time in our bodies. Some PFAS have been linked to harmful health effects in humans, including higher cholesterol levels, immune suppression, low birth weights, and certain types of cancers (ECY, 2022: EPA, 2022a). It is due to their resistance to degradation, and the propensity to bioaccumulate that PFAS are of concern. To date, two of the most concerning compounds perfluorooctane sulfonic acid and perfluorooctanoic acid have largely been phased out of use in the U.S. (EPA, 2016, 2023; Glüge et al., 2020), with more reductions anticipated due to production cutbacks and from limits imposed at the state and federal level.

For the purposes of this review, discussion of analytical results will be centered around PFAS identified in the EPA's 2023 Proposed PFAS National Primary Drinking Water Regulation (NPDWR), 2022 EPA Health-Based Water Concentrations (HBWC), 2022 EPA Proposed Surface Water Aquatic Life Criteria, and 2021 Washington state Department of Health (DOH) State Action Limits (SAL). Results of testing for other PFAS are available upon **request**.

PFAS in Drinking Water

Bellingham began sampling for PFAS in drinking water in 2013 as part of the Third Unregulated Contaminant Monitoring Rule (UCMR 3). For this initial round of sampling, six PFAS compounds were chosen by the EPA for analysis, five of which are represented in state and upcoming federal limits (Table 1). Samples of treated drinking water were analyzed over a year-long period using EPA method 537. No PFAS were detected at the method reporting levels from 10 to 90 parts per trillion (ng/L) in any of the City of Bellingham samples.

Of the 4,920 Public Water Systems that participated in UCMR 3 nationwide, 0.9% reported levels of PFOS and 0.3% reported levels of PFOA above the study reference concentrations of 70 ng/L. PFAS contamination of drinking water supplies was found to stem from two main sources: close proximity to factories that manufactured or used PFAS and being near airports or military bases that used firefighting foams. The results of the UCMR 3 (EPA, 2017) are used to inform future regulatory action by the EPA for public health protection.

Table 1. PFAS with proposed federal limits or state action levels (units in ng/L or parts per *trillion*)

PFAS Compound	Abbreviated Name	WA-DOH State Action Level (2021)	EPA Health Advisory Levels (2022)	EPA Proposed Maximum Contaminant Level (2023)
perfluorooctane sulfonic acid	PFOS	15	0.02	4
perfluorooctanoic acid	PFOA	10	0.004	4
perfluorohexane sulfonic acid	PFHxS	65	9	1* Hazard Index
hexafluoropropylene oxide	HFPO-DA/GenX		10	
perfluorononanoic acid	PFNA	9	10	
perfluorobutane sulfonic acid	PFBS	345	2000	

* Hazard Index (unitless) is calculated according to the following formula:

$$\left(\frac{[\text{GenX}_{\text{water}}]}{[10\ \text{ppt}]}\right) + \left(\frac{[\text{PFBS}_{\text{water}}]}{[2000\ \text{ppt}]}\right) + \left(\frac{[\text{PFNA}_{\text{water}}]}{[10\ \text{ppt}]}\right) + \left(\frac{[\text{PFHxS}_{\text{water}}]}{[9.0\ \text{ppt}]}\right)$$

In 2021 the Washington State Department of Health (DOH) and Department of Ecology (ECY) jointly published a Per- and Polyfluoroalkyl Substances Chemical Action Plan (CAP - ECY, 2022a). Accompanying the CAP were defined State Board of Health Action Levels (SAL) for the five PFAS identified with numerical values in Table 1 above. These values were based on previous federal health advisory levels (EPA, 2016). Advancements in analytical methodology over the past decade now allows for much lower Method Reporting Levels (MRLs) for these analytes. All Group A water systems[1] in the state of Washington are required to sample for PFAS with assigned action levels by Dec. 31, 2025. Subsequent regulatory sampling schedules and public notice requirements will be assigned to each water utility based on the findings of this primary round.

[1] Group A water systems have 15 or more service connections or serve 25 or more people 60 or more days per year.

In 2022 the EPA released a new set of Drinking Water Health Advisory Levels for PFAS chemicals with the notable additions of so called 'GenX Chemicals' and PFBS, which are billed as replacements for PFOA and PFOS respectively. Also of note were the exceptionally low (far below feasible detection levels) advisory levels assigned to PFOS (0.02 ng/L) and PFOA (0.004 ng/L). These changes were made due to emerging evidence that PFOA and PFOS are likely human carcinogens (EPA, 2022a; IARC, 2016). The EPA also announced in 2022 that National Primary Drinking Water Regulation (NPDWR) rulemaking to limit PFAS was underway. Consistently proactive about PFAS detection, the City of Bellingham voluntarily sampled for SAL PFAS in 2022. Once again, no PFAS were detected with the testing methods used.

In March of 2023 the EPA released proposed NPDWR Maximum Contaminant Levels (MCL) for six PFAS (EPA, 2023a). Among the proposed MCLs were levels of 4 ng/L for both PFOA and PFOS, which are right at the level for which those constituents can reliably be measured by current analytical methods. Also included is a combined hazard index for PFHxS, GenX chemicals, PFNA, and PFBS. The hazard index works by examining the sum of ratios determined by dividing measured concentrations by 2022 health advisory levels for these four PFAS compounds (Table 1). Like the mandated Washington state sampling, future monitoring frequency and public notice requirements are proposed to be determined by previous results. Mandated treatment by public water systems is also proposed if PFAS levels exceed regulatory standards (EPA, 2023b).

Going forward, the City of Bellingham will begin sampling for UCMR 5 in 2024. UCMR 5 requires analyses for 29 per- and polyfluoroalkyl substances, including the six listed for regulatory limits under the NPDWR. Strict methodology and reporting limits are applied to UCMR 5 (EPA, 2023c). Due to this, the results from UCMR 5 will be applicable and can be used for both NPDWR and WA-DOH SAL reporting requirements. The results from this monitoring will be reported in the COB's Consumer Confidence Report, mailed to all drinking water customers annually.

PFAS in Wastewater

The City of Bellingham first investigated PFAS in treated wastewater in 2009 as part of a Department of Ecology-sponsored Control of Toxic Chemicals in Puget Sound Loadings study (ECY, 2010). Two sets of samples (winter and summer) from ten publicly operated treatment works (POTW) were analyzed for 13 PFAS compounds to examine Puget Sound basin wide levels. The study found that four chemicals: PFHxA, PFNA, PFOS, and PFOA made up 56 to 87 percent of the total PFAS discharged from each POTW. Bellingham's total perfluorinated compound (PFC) concentrations were among the lowest of the ten Puget Sound POTWs and four regional POTWs from a previous study (Figure 1).

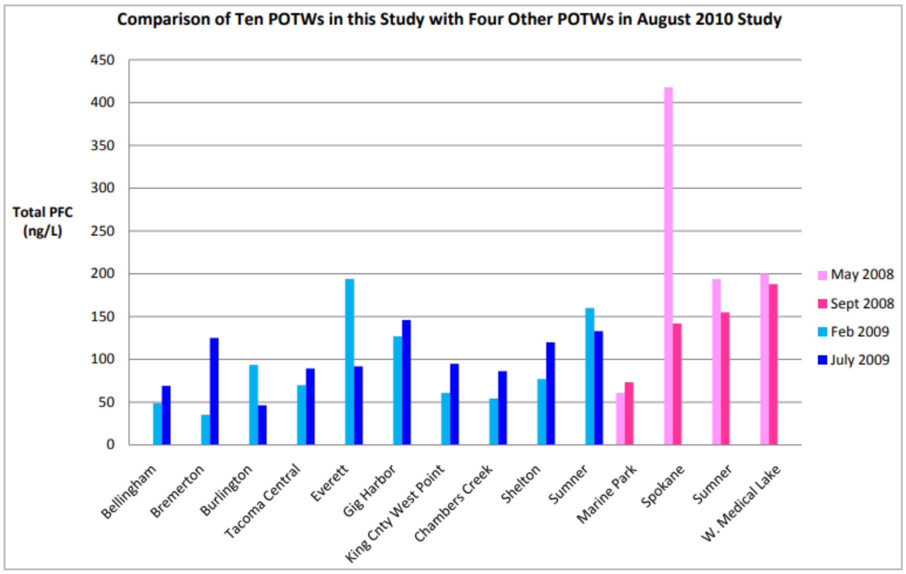

Figure 1. Polyfluorinated compound concentrations from regional POTW. From Control of Toxic Chemicals in Puget Sound (ECY, 2010).

In 2021 the City of Bellingham again sampled treated wastewater for PFAS, as well as incinerator feed solids. These samples were taken to inform utility decisions regarding the future of solids handling in Bellingham. Concentrations for all PFAS measured in treated wastewater were considerably lower in 2021 compared to 2009 (Table 3). They were also mostly below concentrations found at other Washington POTWs in 2022 (ECY, 2022b), and national averages from a 2022 study (Thompson et al., 2022, Figure 2).

Table 3. Prominent PFAS measured in treated wastewater from Post Point POTW 2009 and again in 2021. Comparative results from state and nationwide studies for context. Results in ng/L.

PFAS Compound	Abbreviated Name	2009 COB Concentrations		2021 COB	2022 WA	2022 U.S.
		Winter Conc.	Summer Conc.	Conc.	Conc. Range	Mean Conc.
perfluorooctane sulfonic acid	PFOS	6.02	< 1.98	3.3 J	2.0 - 7.0	10.0
perfluorooctanoic acid	PFOA	11.6	17.4	4.5	5.0 - 12.3	8.4
perfluorohexaesulfonic acid	PFHxS	3.31	2.41	< 1.3	1.0 - 6.0	4.8
perfluorononannoic acid	PFNA	3.52	22	1.3 J	0.6 – 1.1	3.9
perfluorobutane sulfonic acid	PFBS	< 2	< 1.98	< 0.28	7.9 - 27	4.5

< indicates no detection at specified detection level J = an estimate above detection levels but below reliable reporting levels

In 2022 the EPA proposed surface water aquatic life criteria for PFOA and PFOS to protect aquatic life (EPA, 2022c). All results of COB wastewater testing are orders of magnitude below the draft aquatic life criteria concentrations. Note that proposed aquatic life criteria are presented in milligrams per liter (1 mg/L = 1,000,000 ng/L). Draft PFOA criteria are 49 mg/L for acute effects and 0.094 mg/L for chronic effects, while draft PFOS aquatic life criteria are 3.0 mg/L (acute) and 0.0084 mg/L (chronic). While aquatic life criteria are not applied directly to wastewater effluent concentrations, it is indicative that PFOA and PFOS levels found in treated wastewater from Bellingham's Post Point Treatment Plant would not likely have adverse effects on aquatic biota in receiving waters.

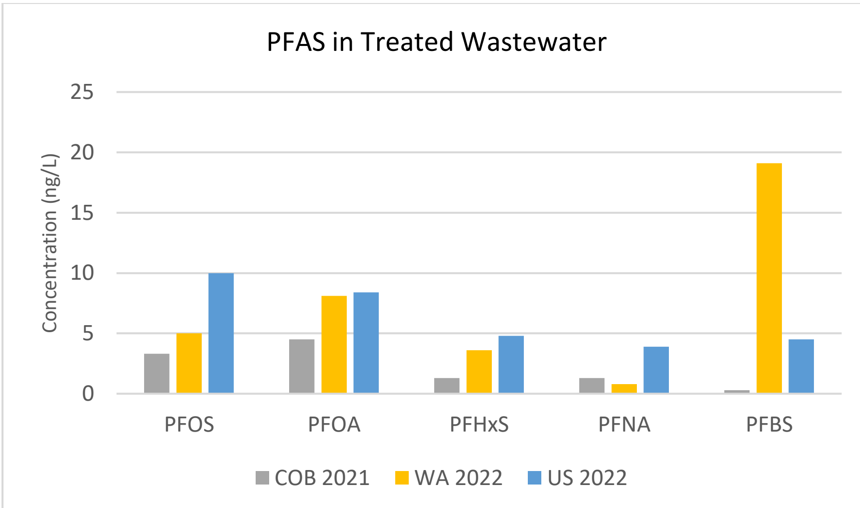

Figure 2. Recent concentrations of PFAS found in Bellingham treated wastewater compared to state and national averages. Results in ng/L

PFAS in Wastewater Solids (Sludge and Biosolids)

There are currently no federal or Washington state regulatory limits for PFAS in the solids that are settled out during wastewater treatment. Analytical methods are still in development and further research is needed to understand PFAS partitioning within the wastewater treatment process. It is known that concentrations of PFAS found in wastewater solids are generally a magnitude greater than that of the associated liquid stream (parts per billion vs. parts per trillion: ECY, 2022b). During 2021 wastewater solids sampling, the City of Bellingham found minimal amounts of PFAS as compared to Washington State and nationwide studies (Table 4).

Table 4. PFAS in COB solids vs. state and nationwide studies. Nationwide results are means of combined sludge and biosolids results. Maine's Screening Levels included for context. Results in ng/g or parts per *billion* – ppb

PFAS Compound	Abbreviated Name	**2021 COB Concentration**	**2022 WA Sludge Range**	**2022 WA Biosolids Range**	**2022 U.S. Combined**	**Maine's Biosolid Screening Levels**
perfluorooctane sulfonic acid	PFOS	3.1 J	21.6 – 36.6	28.5 – 29.1	233	5.2
perfluorooctanoic acid	PFOA	0.26 J	1.53 J - 6.96	0.34 J – 0.99 J	23.8	2.5
perfluorohexaesulfonic acid	PFHxS	< 1.4	ND – 3.94 J	0.44 J – 1.51 J		
perfluorononannoic acid	PFNA	< 1.5	ND – 1.80 J	0.91 J – 1.87		
perfluorobutane sulfonic acid	PFBS	< 1.0	1.45 J – 2.34 J	1.79 J – 4.49 J		1,900

< indicates no detection at specified detection level
ND indicates no detection (detection level not specified)
J indicates result is an estimate above detection levels but below reliable reporting levels

While many states are in the process of determining applicable standards, Maine is currently the only state regulating biosolids as it relates to soil beneficial use applications (state of Maine, 2021). As the City of Bellingham currently incinerates its solids, it should be noted that disposal methods will play heavily into how standards and limits are applied to individual wastewater utilities. It has been suggested that incineration at high enough temperatures (>1400°C) may allow for the complete breakdown of PFAS compounds as it does for related polychlorinated biphenyls (PCBs), but more study is needed (EPA, 2020).

Tightening Regulation and Source Controls

Getting a handle on the sources and mechanisms of transport for PFAS is a priority for the U.S. and state governments. Reductions in industrial production and regulations reducing and/or eliminating the use of PFAS in consumer products is underway. The EPA has proposed designating PFOA and PFOS as hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as the Superfund (EPA, 2022b). If enacted, it would give the U.S. government broad authority for oversight of PFOA/PFOS producers.

While there are treatment technologies available in the water and wastewater treatment industry to reduce PFAS contamination, the preferred approach is to eliminate the source of these contaminants. Many states are in the process of enacting limits or outright bans on PFAS used in consumer products and in industry. Enacted January 1, 2022, Washington state Law 70A.222 effectively banned the use of PFAS in food packaging. Additionally, the Toxic Pollution Law (70A.350) passed in 2019 instructed the Department of Ecology to examine consumer products and restrict the use of PFAS in common items such as carpet, textile, leather furnishings, and aftermarket stain and water resistance treatments. Additionally, as part of the State of Washington Per- and Polyfluoroalkyl Substances Chemical Action Plan future requirements for POTWs to investigate potential PFAS sources in their sewer collection systems are expected. Any identified point sources will likely be required to install pretreatment facilities or discontinue PFAS use.

Conclusion

PFAS regulation and the need for viable mitigation options will continue to increase as the science around these forever chemicals accelerates. The commitment to public health and protecting the environment requires active participation in identifying potential issues and working to resolve them when found. To understand, plan, and develop an appropriate management framework, the City of Bellingham will continue to remain watchful of research efforts involving PFAS in drinking water, wastewater and biosolids. Monitoring for PFAS compounds will continue and the results from sampling drinking water for 29 PFAS compounds will be communicated to all of our drinking water customers.

For Additional Information

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